ART. V.—*On the Modification of the Anæsthetic Process by Hypodermic Injection of Narcotics.* By J. C. REEVE, M.D., of Dayton, Ohio.

IN the *Bavarian Medical Intelligencer* for October, 1863, Nussbaum, the eminent Munich surgeon, published a paper on the maintenance of chloroform anæsthesia during several hours by means of hypodermic injections of narcotics. The mode of administration was alone new in this, the principle had been discovered before. Thus, in 1861, Pitha related a case in which, "after chloroforming the patient in vain [?], he induced twelve hours of complete and placid narcosis by injecting twenty grains of belladonna extract into the rectum."[1] Yet Nussbaum's plan was as much more practical as is the hypodermic mode of introduction of the remedy speedy and reliable in effect compared with the other. His first observation was on a female patient from whose neck he was extirpating a tumour. The operation had already lasted an hour and was not near its termination; fearing further prolongation of the administration of chloroform he gave, hypodermically, a grain of morphia. Not only was narcotism produced but the anæsthesia was maintained; incisions, the application of the actual cautery to check hemorrhage, the introduction of the sutures, caused no movement, and the patient slept on, and some twelve hours elapsed before she returned to consciousness.

Three other observations of the same kind were published at the same time. In one, the patient had previously received a grain of acetate of morphia hypodermically without narcotism; an injection (amount not stated, presumably the same), made during chloroform narcosis and while undergoing extirpation of the superior maxillary, produced a quiet sleep of eight hours' duration, during which pulse and respiration were regular. Injections of half a grain of morphia in a patient of fifty and a boy of seven, produced sleep respectively of five and six hours' duration.

Bernard also accidentally discovered the modifying influence of hypodermic injections of morphia upon chloroform anæsthesia while experimenting on animals. To a dog under chloroform, which showed signs of returning sensibility, he administered five centigrammes [gr. .77] of muriate of morphia, and saw immediately anæsthesia return after it had almost entirely disappeared.

The eminent French physiologist says that this occurred in the same week in which Nussbaum made his first observation on the human subject, and yet he gives the year as 1864.[2]

Immediately after the publication of Nussbaum's observations the Versailles Medical Society applied itself to the investigation of the subject, and the following are the conclusions arrived at :—[1]

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[1] Med. Times and Gazette, March 5, 1864.

[2] Leçons sur les Anæsthetiques et sur l'Asphyxie, par M. Claude Bernard, Paris, 1875, pp. 225-6.

> "1. That salts of morphia, in doses of five to ten centigrammes, injected alone produce a kind of intoxication which may go on to torpor, but do not give rise to insensibility, properly so-called. The effect is not durable, and in a few minutes the animal returns to its normal condition. 2. Salts of morphia injected during anæsthesia produced by chloroform possess the singular property of prolonging the duration of the anæsthesia in proportion to the amount of morphia employed. 3. That this property may be turned to use without danger in man when the duration of an operation gives rise to fears of continuing the anæsthesia by means of chloroform."

Beyond this, Nussbaum's plan seems to have attracted little attention and found few followers. Thus Eulenberg's recent work[2] on hypodermic medication, which seems to be exhaustive of the subject, its bibliography extending even to Australian medical journals, as well as to those of our own country, contains but one or two allusions to this plan of treatment, and but a brief notice of the author's own experience. Bardeleben's surgical clinic at Greifswald afforded him an opportunity of testing Nussbaum's plan in four cases, two resections of the inferior maxillary, a perineal restoration, and the extirpation of a cancerous testicle, the operation much prolonged on account of hemorrhage from a retracted spermatic artery.

> "There was injected respectively three and two centigrammes of morphia [gr. .46 and .3]. A prolongation of the chloroform narcosis over several hours, as Nussbaum describes, was only attained in a single instance, while in the others at most only a transient and by no means certain effect was observed."

The difference between the dose given by Nussbaum and by Eulenberg cannot fail to attract attention, and will be the subject of further consideration.

Possibly Nussbaum's plan has been followed more frequently and more generally than would seem indicated by publications on the subject. To me it seemed one eminently beneficial in many respects, and from the time of its first appearance in our journals I have resorted to it whenever I have had an operation of sufficient gravity to seem to demand it, or one of such a character as to render the effects of an opiate afterwards of probable benefit to the patient. Thus, in such amputations as I have been called on to perform, in several cases of herniotomy, and in a few cases of ovariotomy which have fallen to my lot, I have always given hypodermically a dose of morphia varying from two- to three-fifths of a grain, and believe that my patients have been benefited in the prolonged anæsthesia, and by the relief of pain and the quiet sleep following the operation.

I am aware that there is wide difference of opinion as to the beneficial effect of opium after operations. Thus Peaslee[3] says :—

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[1] Med. Times and Gazette, May 28, 1864.

[2] Die hypodermatische Injection der Arzneimittel, von Dr. Albert Eulenberg, Dritte Auflage. Berlin, 1875.

[3] Ovarian Tumours, p. 489.

> "The hypodermic injection of morphia immediately after the operation [ovariotomy] adds much to the depressing effect of the operation, and should be, as a rule, discountenanced."
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> Mr. Humphey says:[1] "Immunity from pain is dearly purchased by the languor and enervation which often follow the opiate. As a general rule I prefer that my patient should run the risk of a sleepless night after an operation rather than incur the effects of a sedative."

Those who hold these views will not be likely to follow Nussbaum's plan; but my experience of its benefits has been such as to outweigh a very large amount of authority against it.

I presume that I should have continued indefinitely the hypodermic administration of morphia immediately before operations, had I not learned what I believe to be a far better plan, which is to administer the narcotic at a longer time before the operation, say from twenty-five to forty-five minutes. For a knowledge of this plan I am indebted to the work of Bernard already quoted, a work which contains all the information upon this subject which has yet met my eye, a work, too, so interesting and valuable in many respects, both therapeutically and physiologically, that it is surprising how little notice it has received from medical journals.

Bernard states, that, after the hypodermic injection of morphia preceding the administration of chloroform, the course of events is not the same, but some new and very interesting facts are developed. The most important of these are, the very much smaller amount of chloroform necessary to produce anæsthesia, and the more profound insensibility of the animal under the combined influence of the two agents. We quote from his lectures:—

> "You see how admirable is the effect of this action of chloroform added to that of morphia. I know no other means of immobilizing animals in so complete a manner. This enables the physiologist to overcome one of the greatest difficulties he meets with in operating on living subjects; he has thus the means of rendering them inert while the phenomena of life still go on. The animals, as you see, are in a state of absolute resolution, their limbs are flaccid, and they can be placed in any position, they are like warm cadavers, and they can be kept in this state a long time, during half a day if we wish, a time abundantly ample for the longest operations." (pp. 227–8.)
>
> Again, "You see in this dog how complete is the state of relaxation, of muscular relaxation, which is obtained by this addition of the effect of chloroform to that of morphia. By the aid of this means, as I have already said to you, the most difficult experiments can be easily executed. Thus, in this dog which is before you, we have been able to penetrate to the bottom of the mouth, and into the pharynx, to divide the lingual nerve at its place of emergence, which, in a dog in the normal state, or either simply chloroformed, or under the influence of morphia alone, it would be impossible to do." (p. 270.)

We must refer to the work itself for detail of the experiments. It may be well to give the views of so eminent an authority as M. Bernard as to the mode of operation of these powerful therapeutic agents when their effects are combined.

> "First of all there is one thing to declare formally, that there is here simply superposition of two effects without either combination or antagonism properly speaking. The two effects, in being superposed, remain distinct, and neither

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[1] Address in Surgery, British Medical Association, 1864.

is modified. Besides, I have never seen it otherwise in all the cases in which antagonism between medicines or poisons has been claimed to exist, for example, in the case of curare opposed to strychnia, atropia opposed to morphia, etc." (p. 266.)

It remains to present the experience which has been obtained of this plan of treatment in the human subject, and for this we can only quote from the same work. Since the first publication, in 1869, of the results obtained by him on animals, M. Bernard tells us, French surgeons have begun to apply the method in practice, and he gives in detail the experience of some who have tested it.

M. Guibert reported to the Academy of Sciences in 1872 (Seance 18 Mars), the results he had obtained. He noted two distinct states according to the dose employed, one of analgesia and one of anæsthesia, the former being "insensibility to pain, with conservation of intelligence, of consciousness, and of voluntary movement," and sufficing for the operations of minor surgery and for obstetrics. Fifteen of his observations are accouchements, and we fail to see any advantage in the preliminary use of the morphia, over what we daily observe in the use of chloroform alone. One case, however, must be excepted, and we give it as reported, hoping that the future will confirm the value of the procedure in such cases. It was a case of version " performed for a presentation of the trunk more than sixteen hours after escape of the waters, executed with the greatest facility in this analgesic state, while the patient continued to answer questions addressed to her and did not utter a single cry. The combined action of chloroform and morphia had completely abolished the contraction or retraction of the uterus, which, in these conditions, renders version so difficult for the accoucheurs and so painful to the mother."

MM. Labbé and Goujon reported, to the Academy of Sciences on the 26th of February, 1872, four observations of this mode of treatment. We copy two of them as examples, and they do not differ materially from the others:—

"On the 27th of January, M. Labbé, at La Pitié, performed a submalleolar amputation upon a young man. Twenty-five minutes before the operation, there was injected into the inner surface of the thigh two centigrammes [gr. .3] of muriate of morphia. The chloroform was given, and produced moderate excitement; at the end of seven minutes anæsthesia was complete, and prolonged a good while after the operation, which lasted seventeen minutes. The quantity of chloroform expended was twenty-eight grammes."

"A young woman about to undergo ovariotomy received hypodermically two centigrammes of muriate of morphia. The chloroform was administered twenty minutes afterwards. A light period of excitement was manifested, and the anæsthesia became complete at the end of six minutes. The operation lasted one hour and forty-five minutes, and the chloroform expended during this time was forty-eight grammes. During all this time the patient was in a state of complete resolution, and she awoke very calmly after the operation, saying that she had felt nothing and had then no pain."

The following are the conclusions of these gentlemen, drawn from their experience:—

> "1. Anæsthesia can be produced in man, as M. Bernard has shown in animals, much more rapidly by combining the action of chloroform and morphia.
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> "2. That this anæsthesia is of longer duration and can be prolonged for a very considerable time with small doses of chloroform, and that from this fact, the risk of fatal accidents may be considerably diminished."

The most extensive series of observations are those by MM. Rigaud and Sarazin made at the hospital of Strasburg. A detailed report is given of fifteen operations, of various grades of severity. The amount of morphia used was small; in several of the cases five milligrammes only (gr. .077), in several one centigramme (gr. .15), in two only it amounted to a little over one-fifth of a grain. The conclusions of these gentlemen are also appended:—

> "1. The doses of morphia do not need to be very large in order to be efficacious; but, then, the injection should precede the operation by at least forty minutes.
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> "2. If an operation is to be practised immediately, an injection of morphia will augment the period of excitement, and if the dose is tolerably large, accidents on the part of respiration may occur, as in Case XIV. Nevertheless, the period of excitement is short, resolution is rapidly obtained, and the awakening may take place completely and in a very short time.
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> "3. The association of morphia with chloroform is useful in operations of long duration, or in cases where prolonged anæsthesia is necessary.
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> "4. It is contra-indicated in such operations as require that the patient assist the surgeon, above all, in operations on the face, where there is risk of blood entering the air-passages.
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> "5. After operations from which anæsthesia has been obtained by this combination, less unpleasant effects [moins des malaises] are observed, and the patient enjoys a repose favourable for the result of the operation, and which may prevent many of the consecutive accidents of surgical operations."

The above reference to Case XIV. would prompt the inquiry, if it did not spontaneously arise, as to any increase of danger arising from this mode of treatment. In this case the patient was a man aged 53 years, of originally good constitution, but somewhat enfeebled; the operation, amputation of the leg; two injections were made of one centigramme and of five milligrammes of morphia; symptoms of embarrassed respiration manifested themselves during the anæsthetic process, with congested face and cyanosed lips; the tongue was drawn forward, and recovery soon took place. In Case XVII. there were more marked dangerous symptoms; one centigramme of morphia was given immediately before the operation; the patient was 62 years of age, a hard drinker, and of broken constitution; moreover, after examination showed marked signs of fatty degeneration of the heart. The latter, then, was a very bad subject for chloroform under any circumstances, and in the former the symptoms were such as chloroform produces alone. Eulenberg, however, publishes a fatal case, reported to him by Dr. Bartscher, which occurred in the hospital at Osnabruck. The patient was a badly nourished peasant, aged 58 years. After he was narcotized with three drachms of chloroform, one grain of acetate of morphia was injected into the upper arm. The operation, for removal of fibrous polypus of the fauces by incision, was then proceeded with and completed. The patient awoke, was led back to his chamber, helped undress himself, and got into bed. "He slept quietly about an hour; as now stertorous respiration began, and the patient could not be wakened, I was called. He presented all the appearances of dying; he lay upon his back, with his mouth partly opened, pale, cold face, cold hands and feet, small, slow pulse, very low temperature." Death took place eleven hours afterwards by "paralysis of the lungs" in spite of all efforts at resuscitation, and the *post-mortem* showed no blood in the air-passages, nor gave any explanation of the fatal termination.

Surely this was a death from the narcotism of opium. The report does not mention the state of the pupils, nor give the rate of respiration; yet the time at which the bad symptoms began, their character, and the mode of death, all point out in one direction for an explanation of the death. Moreover, there is further evidence, we think, in the amount of morphia administered, and we indicated our intention of returning to this point. There can be, we think, no doubt that a grain of morphia administered hypodermically, unless in the case of patients already accustomed to the use of this narcotic, is too large a dose to be given without risk. The report of Nussbaum's original cases shows this undoubtedly in the length of time deep sleep continued after the operation, and despite the high authority, we cannot think any prudent practitioner would venture on half a grain to a boy seven years old!

My own experience of the injection immediately before or during anæsthesia can only be given in a general way. As before stated, I have resorted to it for a considerable number of operations during the past eight or ten years. The results have been satisfactory; I have seen no symptoms of danger, while in the prolonged anæsthesia, and the quiet and absence of pain afterwards, there has been ample proof of the value of the plan.

Too short a time has elapsed since Bernard's lectures appeared to afford much opportunity for testing his plan of administering the narcotic some time before the chloroform. I append two cases.

CASE I. Patient a healthy man, aged 58 years, right wrist traversed by circular saw, amputation at the joint. Twenty-five minutes before administering the anæsthetic, which consisted of the mixture of one part alcohol, two parts chloroform, three parts ether—the anæsthetic I invariably use except for children and in obstetrics—he received a hypodermic injection of eight minims of a mixture containing sixteen grains of morphia and half a grain of atropia to the ounce. He passed into the state of anæsthesia rather more slowly than usual, on account of shallow respiration, but there was no excitement; the anæsthesia once obtained was profound, he did not move or groan during the operation, his extreme quiet reminding me of what Bernard says of dogs. He awoke in due time, was quiet and comfortable, and had no vomiting. The amount of mixture expended was one and a half ounces.

CASE II. Patient aged 38, operation ovariotomy, double, weight of tumour removed 36 pounds. Twenty-eight minutes before anæsthetizing, an injection was made of twelve minims of the same mixture as above. As she was on the table, and just before administering the anæsthetic, another injection was given of six minims of a solution of atropia, one grain to the ounce. It is safe to count one minim as lost in these injections. She manifested somewhat more excitement than usual for a female while passing into the state of anæsthesia. The operation lasted one hour; during it the patient was extremely quiet, she once raised one hand, which was the only movement, and she did not groan. Her pulse kept up remarkably well, her capillary circulation as shown in her lips was excellent, and her condition during and after the operation excited the comment of medical gentlemen present, and contrasted with what they had ever seen under chloroform. After removal to bed, she complained of no pain, and enjoyed a quiet sleep. No vomiting. Recovery followed, but only after a protracted diarrhœa, probably septicæmic in character. The amount of anæsthetic mixture expended was eight ounces.

The atropia was administered in this case for an especial purpose, the maintenance of the circulation and the vital powers during a protracted operation; and to counteract the depressing effect of long-continued anæsthesia, and this, we believe, to be another modification of the anæsthetic process by hypodermic injection well worthy of attention. Especially will it prove beneficial when chloroform alone is used. Nothing is better established than the depressing effects of this great remedy upon the functions of the heart, while the powerful stimulating influence of atropia is among the more recent contributions of experimental physiology to medicine, which has not yet received a tithe of the attention it deserves, although the facts in regard to its action have been for some years before the profession, and emanate from very high authority. Harley,[1] after giving the details of experiments with it, says:—

> "If we take the simplest view of its action, it is that of direct and powerful stimulation of the sympathetic nervous system, and it may be regarded as the only one. During the operation of medicinal doses the heart contracts with increased vigour, the arteries increase in tone and volume, the capillary system fully participates in this general excitation of the circulation, and a diffusion of warmth is felt throughout the body."

Bartholow[2] bears the same testimony. Giving briefly the conclusions he arrived at, they were that atropia exerts a powerful stimulating effect on the heart, and produces a rise of temperature to the amount of a degree. It increases the activity of the organic nervous system, as shown by increased tonicity of the arterioles, increased action of the heart, and rise of bodily heat. He distinctly recommends its use hypodermically previous to the inhalation of chloroform, as a means of lessening the dangers of paralysis of the heart and of respiration.

It is carefully pointed out by Harley that, if the dose be large, exhaustion rapidly follows increased action, and, therefore, to obtain the stimulating effects of the remedy but a small dose should be used, say from the one ninety-sixth to the one forty-eighth of a grain.

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[1] The Old Vegetable Neurotics, 1869.

[2] Prize Essay: Trans. Amer. Med. Assoc., 1869.

ART. VI.—*On the Medical and Dietetic Treatment best adapted to the Physical Restoration of Confirmed Inebriates.* By ROBERT P. HARRIS, M.D., Attending Physician to the Franklin Reformatory Home, Philadelphia.

WE do not propose in this article to enter upon the treatment of any of the serious chronic organic diseases which result from the long-continued use of alcoholic stimulants, but simply those direct conditions of disease which we are all liable to be called upon at any time to remedy in the debauchee, made sick by over-indulgence, whether of a few days, weeks, or months; or it may be of a much longer period. Few drunkards are regularly periodical, or continuously habitual; most of those we are called upon to treat being alternately moderate and excessive; or abstinent, and again immoderate.

The diseased conditions referred to are vomiting, inordinate thirst, diarrhœa, hemorrhage from the rectum, epileptic convulsions, nervous tremors, morbid wakefulness, delusions of sight or hearing, or both, and maniacal attacks. Physicians in both private and public practice are called upon to administer to their relief, and, if possible, restore them to sound health—often only, it is true, that they may be ready in a few days or weeks to resume their old habits—a very unthankful position, but one which may occasionally enable us not only to save the life of the patient, but put him in a position to reform his habits, and become a useful member of society, instead of being a curse to it and his family.

The opinion was long held by physicians, and still is by many whose experience has not led them to change their views and practice, that there is very great danger to the inebriate in suddenly cutting off all his customary stimulus, and that mania is almost sure to follow such a practice when the party has been drinking steadily and largely for a long time. Hence, to avoid this presumed danger, the system known as the "*tapering off*" was adopted, and is still adhered to by many; that is, to gradually diminish the amount of stimulus, day after day, until it is believed safe to stop it altogether. We have faithfully tried this plan, as well as the "*sudden stoppage system*," and are firmly convinced that the latter has every advantage over the former, and especially in the cases where, according to the old theory, there should be the greatest risk.

During the last three and a half years we have had under our care at the Franklin Reformatory Home for Inebriates more than five hundred